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IMPLEMENTATION AND ACCEPTANCE TESTING OF THE SEISMIC COMMUNICATION AND CONTROL PROCESSOR

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Alexandria, Virginia 22314

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IMPLEMENTATION AND ACCEPTANCE TESTING OF THE SEISMIC COMMUNICATION AND CONTROL PROCESSOR

PRINCIPAL INVESTIGATOR: Howard W. Briscoe
Telephone (617) 491-1850 Ext. 415

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Prepared by:

Computer Systems Division
Bolt Beranek and Newman Inc.
Cambridge, Massachusetts 02138

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LIST OF ACRONYMS

ALPA	Alaskan Long Period Array
BCP	Bus Coupler
CCA	Computer Corporation of America
CCP	Communication and Control Processor
DDT	Dynamic Debug Technique
DP	Detection Processor
EP	Event Processor
FTP	File Transfer Protocol
HIT	System Test Program
HLC	Host/IMP Interface
KSRS	Korean Seismic Research Station
LASA	Large Aperture Seismic Array
MI	Memory/Input Output
NORSAR	Norwegian Seismic Array
PID	Pseudo Interrupt Device
SDAC	Seismic Data Analysis Center
SIP	Seismic Input Device
SPS	Seismic Processing System
TAG	Memory Timing and Gating

SUMMARY

This is an interim report reviewing the implementation and acceptance testing of the seismic Communication and Control Processor (CCP) installed at the Seismic Data Analysis Center (SDAC).

The Communication and Control Processor (CCP) is the central node in the communication system for the VELA Network. The CCP receives data from the on-line seismic stations, reformats and regroups the data, and transmits the data to the archival store, the SDAC processing center, and other destinations as required. The CCP also maintains information on the status of the VELA network and performs some quality control and signal processing operations.

The CCP is a 4 processor system using the PLURIBUS multiprocessor architecture. It was installed at SDAC in July 1975 and acceptance testing was completed in February 1976.

INTRODUCTION

As part of the effort under the VELA program for improving the capability to detect and identify underground nuclear explosions by seismic means, ARPA is supporting the development of a world-wide network of seismic stations. Some of these stations will communicate on-line with the processing center at the Seismic Data Analysis Center (SDAC) and with a large archival storage system at Computer Corporation of America (CCA). The system design makes use of both leased lines and the ARPA Network for communications in this seismic network.

SYSTEM IMPLEMENTATION

The CCP was implemented using the BBN designed PLURIBUS multiprocessor system based on the Lockheed Electronics SUE minicomputer. The PLURIBUS system uses a novel control scheme that permits elimination of processor specialization and produces a highly modular system. The PLURIBUS does not employ interrupts. Instead it uses special hardware, called a PID or Psuedo Interrupt Device, to implement a "task queue" for all processors. This approach allows construction of systems which degrade gracefully, automatically trading performance for module failures while continuing to execute all application functions. PLURIBUS systems are bus oriented and are built up from four basic types of busses: Processor busses, Memory busses, Input-Output busses, and Memory/Input Output busses. The initial configuration for the CCP contains two Processor busses and two Memory/Input Output busses.

The CCP system also contains a Tektronix display and hard copy printer, 2 Texas Instruments Silent 700 terminals, 3 CODEX 4800 b.p.s. modems, and a REMEX paper tape reader/punch. The PLURIBUS, tape reader/punch, and modems are mounted in three racks.

The CCP contract was awarded in September of 1974. Within a month of that time most of the hardware was on order. The Hardware and Software Development Specifications were completed early in November and work was begun on software implementation. The system hardware was assembled in January 1975 and was available part time for program checkout in February. The first versions of most of the software modules were coded by June 1975.

Meanwhile, design and implementation of other nodes in the seismic data network were in progress. As coding of software for various nodes in the network progressed, it became evident that modifications to the communication protocols would be necessary.

As these changes were defined modifications to the CCP programs had to be made.

Software checkout prior to CCP delivery was facilitated by temporarily routing some of the leased line inputs to BBN. Realistic system level checkout was not practical, however, until the equipment was delivered to SDAC and other nodes in the network were available for testing.

The equipment was shipped in July 1975 and installation was complete early in August. By then it was evident that the network would not be ready for system level tests in time for scheduled system completion, and that further protocol and format modifications would be required. The contract was, therefore, extended to the end of calendar 1975.

CCP ACCEPTANCE TEST

The CCP acceptance tests were started in November of 1975. The delivered system included the hardware, the application system software, PLURIBUS "reliability" system software, test and diagnostic programs, and program support software. Acceptance tests were divided into five phases. In the first phase, the hardware and the hardware test programs were demonstrated. In the second phase the operational system was demonstrated in the full operational configuration. The third phase demonstrated the reliability software that allows the system to dynamically recognize the available working system resources, to adapt the operation to use these resources, and to operate the system in a divided configuration with part of the system hardware running test programs or software development while the rest of the system runs the operational system. Phase 4 consisted of a 24 hour system demonstration in normal operating configuration. Phase 5 was a demonstration of the program support software operating on a TENEX system.

The detailed acceptance test procedures are described in BBN Report 3185 which is included as Appendix I of this report. Since coordination was required among many of the operating sites, the test procedures were not performed in the order described in the test procedures document. Table 1 summarizes the dates on which each part of the test was performed. As can be seen from this table, the test period stretched out till February of 1976 before final system acceptance.

The acceptance test results include the output from the CCP output terminal, hard copy from the CCP display, and computer dumps, listings and plots from other sites sending and receiving data directly to or from the CCP or in parallel with the CCP. These results have been bound in three volumes in order to make it easier to compare concurrent data from different sources.

Table 1

Acceptance Test Schedule

date	day number	Test Procedure
November 3,4,1975	307,308	1 - System Testing
November 11, 1975	315	2A - Operating the Display
		2B - Processing ALPA Data
November 13, 1975	317	2D - Processing LASA Data
November 14, 1975	318	2F - Receiving KSRS and Site II Data
November 18, 1975 and December 12, 1975	322 and 346	2E - Processing NORSAR Data
November 25, 1975 and January 12, 1976	329 and 12	2G - Processing Data for the VELA Circuit
December 3, 1975,	337	2I - Sending Data to the DP
December 11, 1975	345	2K - Check All Messages Between CCP and DP
December 16, 1975	350	5 - Demonstrate Editor and Assembler
December 17,18,1975	351 and 352	2C - Test ALPA Beams
January 8, 1976	8	2L - Sending Data to the SIP
December 12, 1975	336	2M - Check All Messages Between the CCP and the SIP
January 16, 1976	16	2H - Changing and Interrogating CCP Status
January 16,17, 1976	16 and 17	2J - Testing Changes in Data Status
January 16, 1976	16	3 - Reliability
February 4, 1976	35	Sample Event
February 5,6, 1976	36 and 37	4 - System Operation

These volumes are organized according to the test procedures document rather than chronologic order of test performance.

The following section summarizes the test observations.

PHASE 1. HARDWARE SYSTEM TESTS

This phase was divided into three parts. In the first part the hardware system test program, HIT, was demonstrated. The version demonstrated was a later version than that described in the original test procedures. The final test procedure document (Appendix I) has been corrected for the later version of HIT.

The second part of this phase required that known faulty cards be inserted into the CCP and the fault isolated with HIT. Three faulty cards were made available, an HLC, a TAG, and a BCP. The HLC (Host interface) card was chosen and found using HIT. Next both the bad HLC and the bad TAG (a memory card) were inserted. Again the HLC was found but the TAG actually had three missing connections and the memory test couldn't isolate the problem to the card, but only to the bus. It would have been necessary to examine the bus signals with a scope to isolate the problem further.

The final step in this phase was to run HIT for 24 hours with no errors.

HIT stores error counts and indicators in designated memory locations which must be examined using the DDT program or console lights. The test results from phase 1 are, therefore, contained entirely in the interactive teletype output (Volume 1 of test results).

PHASE 2. OPERATIONAL PROGRAM TESTS

The various tests of phase 2 check individual data paths and processing results and then the system as a whole. In order to explain these tests, figures 1 and 2 show two basic network configurations used. In configuration 1 (fig. 1), both the "old" Detection Processing (DP) system and the "new" DP system are run simultaneously in different 360/40 computers in order to provide a data path independent of the CCP for comparison. In configuration 2 (fig. 2), the second 360/40 is used for the Event Processing (EP) system.

The tests in phase 2 fell into three groups. The first group consisted of tests with individual sites on the network. For these tests the test data consist of dumps and/or plots of the data at the site and at the CCP. The sites tested individually include ALPA (test 2B), LASA (test 2D), NORSAR (test 2E), KSRS and Site II (test 2F), and the VELA circuit (test 2G). The second group of tests consists of testing CCP internal processing including the CCP display (2A), ALPA beamforming (2C), examination of status of both the CCP system and the network and control of the data flow through the CCP (2H), and smoothing and checking of data status (2J). The test data from these tests consist of the interactive teletype output, the output teletype output, and the CCP display output. The third group of tests combined testing of CCP output to the SIP and DP with overall system tests. These include tests 2I and 2K with the DP, and tests 2L and 2M with the SIP. For these tests an attempt was made to collect data from each node from the data source sites through to the final destination at the SIP and DP with as many data streams as possible operating simultaneously. Thus, the data from these tests include dumps and plots of data at the source sites, the CCP, and the SIP and/or DP. In addition, tests 2K and 2M involved testing the protocols for communication between the CCP and the DP and SIP. Data from protocol tests consists of dumps of messages and observations that specified events occurred in response to special protocol messages.

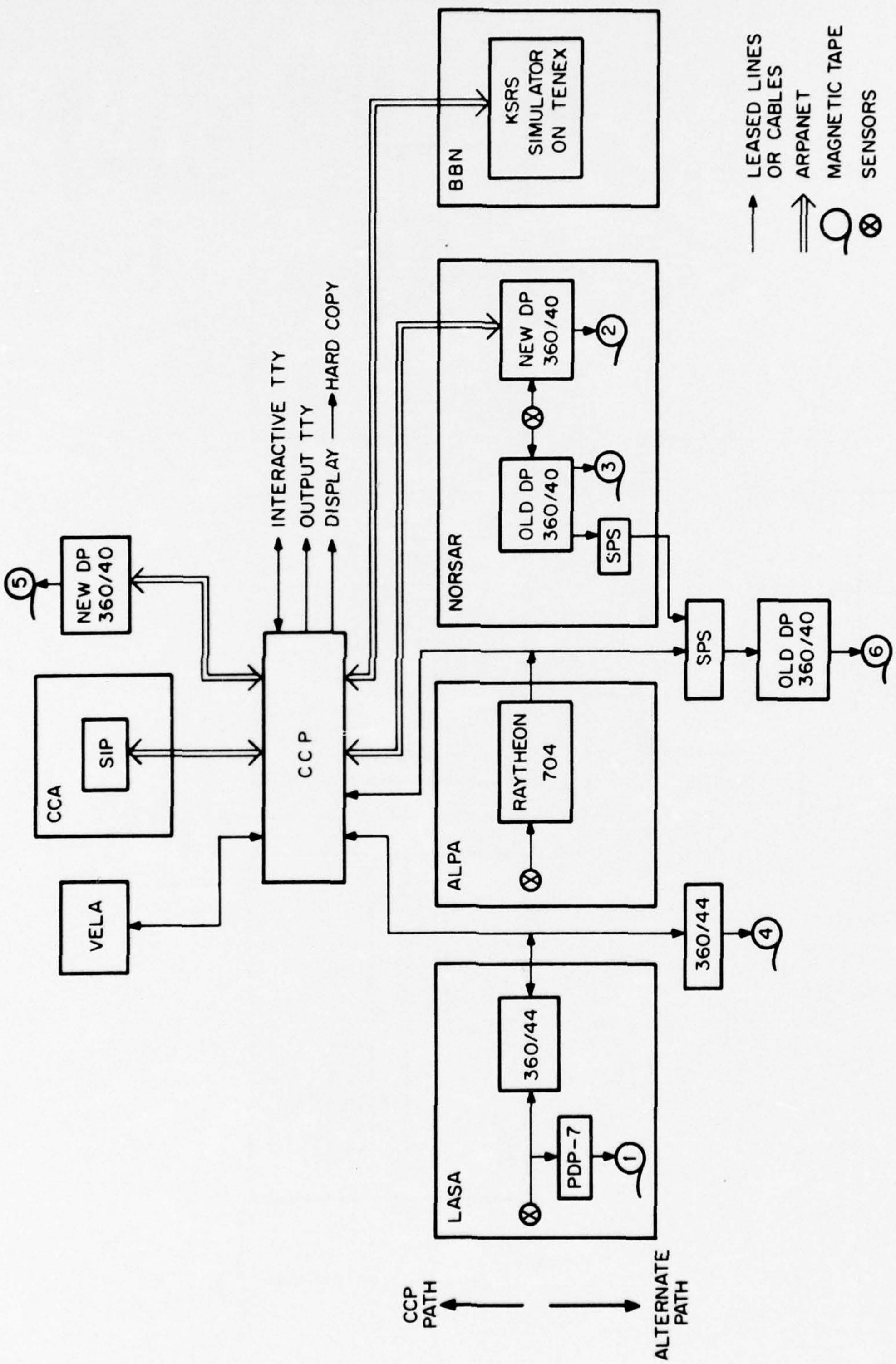

Figure 1
Test Configuration 1

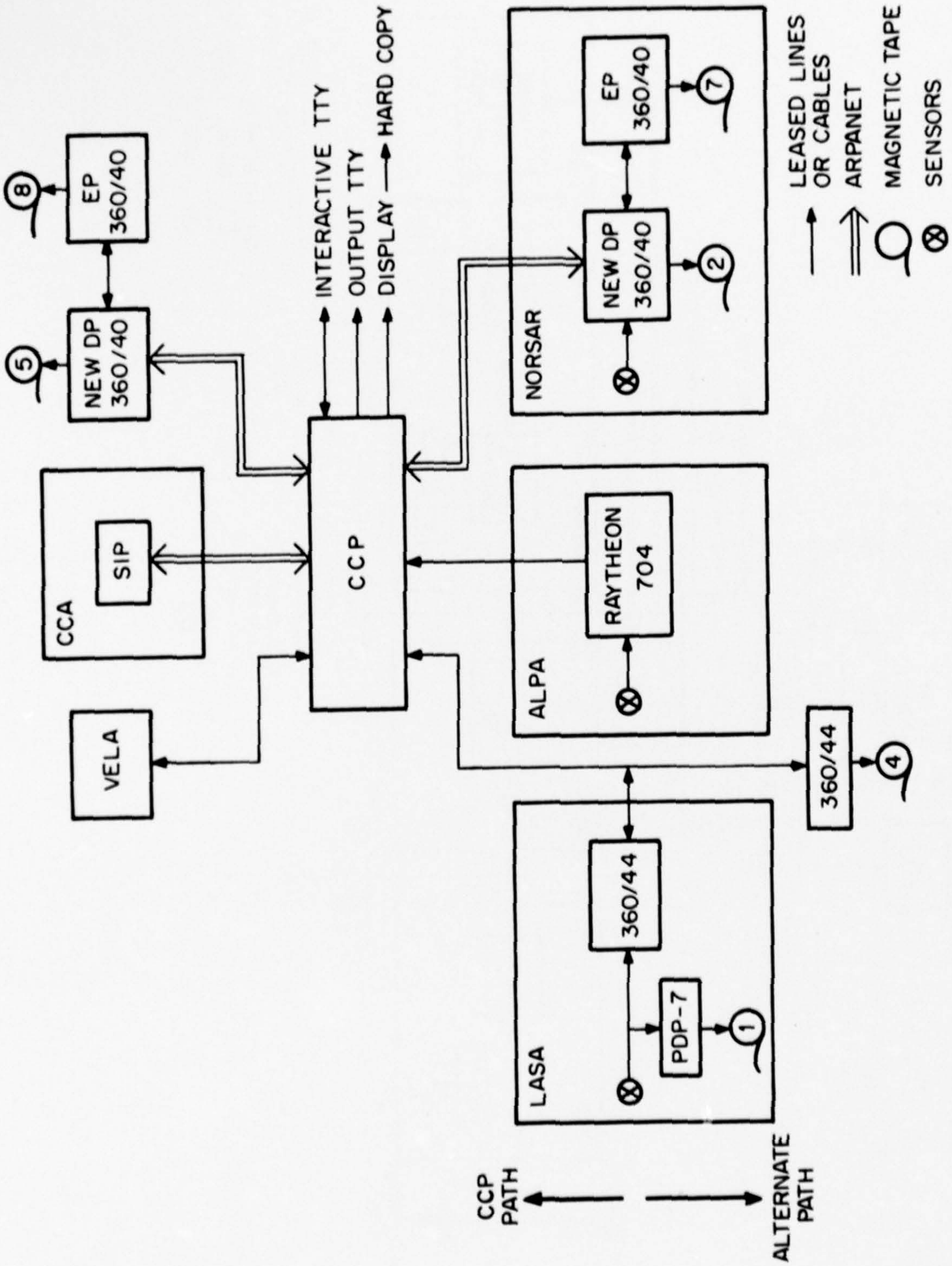

Figure 2

Test Configuration 2

Testing with Individual Sites

2B-ALPA

The ALPA site does not have a convenient way of dumping data at the station for comparison with data from the CCP. This test was, therefore, performed by putting the system in configuration 1 and outputting ALPA data from the "old" DP output tape (tape 6) as an independent measure of the site data for comparison with data transmitted through the CCP.

The tests were performed during a period from about 18:30 to 19:30 on November 11, 1975. The test data consist of 1) the CCP interactive TTY output including operator commands and core dump data, 2) five plots from the CCP hard copy unit showing ALPA waveforms, 3) corresponding plots of ALPA data from the "old" DP output tape, and 4) a hex dump from the "new" DP output tape of the corresponding ALPA data.

2D-LASA

For this test the system was operated in configuration 1. There are two data paths independent of the CCP, one path is the recordings made at the site (tape 1): and the second uses the 360/44 at SDAC to monitor the incoming phone line in parallel with the CCP (tape 4). The data format is not compatible with the "old" DP input from LASA so no LASA data appears on tape 6.

The tests were performed on November 13, 1975, from about 19:30 to 21:00. The test data consist of 1) the output from both CCP terminals including operator commands and core dumps, 2) eight plots of waveforms from the CCP hard copy output, 3) plots and tape dumps from the 360/44 tapes, 4) plots of data from the "new" DP system, and 5) strip chart recordings and tape dumps from tapes recorded on the PDP-7 computer at LASA.

During these tests it was noted that the plot scales available on the CCP display did not allow enough scales for the convenient display over the dynamic range of interest and that there were not enough standard instrument scales for beams, subarray beams, and sensors to have independent high and low gain factors.

In addition to data messages it was necessary to demonstrate operator messages in both directions and the "idle" messages sent from the CCP to LASA. Operator messages were confirmed by the exchange of messages recorded on the interactive and output terminals of the CCP. The idle messages were confirmed by inhibiting them at the CCP and observing that the lack of these messages was detected at LASA.

2E-NORSAR

The station tests with NORSAR were more complex than with other sites because, in addition to operator and raw data messages, the exchange of processed data had to be tested and the raw data exchange goes in both directions. The raw data exchange was tested in configuration 1. The tests of the processed data exchange required that the Event Processing (EP) systems be running. These tests used configuration 2 with the second 360/40 at each site running EP systems instead of the "old" DP systems. Additional notes on the test plans and preparation and charts of the data channels used in the tests are included in Volume 2 of the test data.

Most of this test sequence was successfully completed on November 18, 1975 (day 332) from approximately 17:00 to 19:30. During this period it was found that type 10 messages were not being passed to the DP at SDAC, and additional tests to demonstrate successful processing of type 10 messages were performed on December 2, 1975 (day 346).

The data from these tests include 1) both CCP teletype outputs including dumps of data buffers for comparison with other plots and listings, 2) 13 waveform plots from the CCP hard copy printer, 3) plots and listings of data from the "old" DP tape from both NORSAR and SDAC (tapes 3 and 6), 4) plots and dumps from the "new" DP systems (tapes 2 and 5), 5) listings from NORSAR and SDAC detection logs, 6) listings of detection logs received at NORSAR and SDAC from the other source, 7) plots from the PDP-7 tape (tape 1) and the 360/44 tape (tape 4).

A plot of NORSAR subarray beams from the SDAC output tape which appears to disagree with plots made at NORSAR is included in volume 3 of the test data. The source of the discrepancy was not identified so this test of handling of subarray beams was inconclusive.

In addition to data and processed data the exchange of operator messages and data requests were tested.

2F-KSRS and Site II

Since KSRS and Site II were not operational, handling of data from these sites was tested using a simulator on the BBN TENEX system. The simulator transmitted known levels and saw-tooth waveforms in the appropriate KSRS format. The output from these tests consisted of 1) outputs from both CCP terminals including core dumps of data and 2) plots of waveforms from the CCP hard copy printer. These outputs were compared with known simulated data.

These tests were conducted on November 14, 1975 (day 318).

2G-VELA Circuits

Primary tests of the output to the VELA circuits were conducted on November 25, 1975 from about 13:00 to 20:00. The test data consist of 1) the output from both CCP terminals including coredumps of data buffers, 2) five plots of waveforms from the CCP hard copy printer, 3) plots, listings, and Helicorder records of data from the VELA circuits.

The test data volumes also contain notes on the test plans and preparations and additional plots and listings from the VELA circuits, the CCP, and the DP recorded on January 12, 1976.

CCP Processing Operations

In addition to acting as a communication switch the CCP performs several internal functions including displaying waveform and test data, computing a small set of beams from the ALPA data, monitoring incoming data to determine status of sensors and communications, and, of course, allowing the operator to control the data routing.

2A-Displays

In this test, the various commands for selecting and modifying the data displayed on the Tektronix terminals and the output typewriter were demonstrated. Test data consist of the records from the two typewriter terminals and hard copy from the display. It was evident from these tests that more flexibility in controlling display scales and a more convenient procedure for specifying the display format would be important for intended CCP operations.

2C-Beamforming

The beamforming calculations consist of rotating the 3 components of the raw sensor data, adding data from all the sensors of each component with preselected delays, and performing specified quality control functions including removal of input sensor bias. The beamforming function was demonstrated by forming a selected set of beams and dumping both the beam outputs and the input data. The calculations were then checked by hand calculation of several beam values. In addition, the beam outputs were compared with beams formed using the "old" DP system. The tests used configuration 1.

These tests were performed on December 17, 1975 (day 351) approximately 01:30 to 02:15 and on December 18, 1975 (day 352) from about 17:30 to 19:00. The test data include 1) both CCP terminal outputs, 2) 7 waveform plots from the CCP hard copy device (one on day 351 and six from day 352), 3) SDAC develocorder record, 4) dump and plots from the "new" DP output, 5) dump and plots from the "old" DP output, 6) hand calculation sheets.

2H-CCP and Network Status

Commands for interrogating the status of the CCP and the other network stations and for controlling the flow of data through the CCP were demonstrated in this test. Test output consists of the typewriter records from the CCP. The tests were conducted concurrently with test 2J-Sensor Status on January 16, and the test data are filed under test 2J.

2J-Sensor Status

The smoothing and monitoring of sensor and communciation link status and the generation and transmission of status mess-

ages were demonstrated in these tests. The tests were conducted on January 16 and 17 (across the change of day to test the automatic daily status message) of 1976.

The test data from this test consist of 1) output from the CCP terminals, 2) a CCP hard copy plot and a dump of the type 8 message when ALPA data was stopped by disconnecting the input (these are in test data Volume 3), and 3) a hex dump showing type 7 and 8 messages transmitted at the change of day.

Output and System Tests

These tests were primarily intended to demonstrate the output of data from the CCP to the SIP and DP, but they were also used as an overall system demonstration . For each test, an attempt was made to operate with LASA, ALPA, and NORSAR all providing data and to record and compare data at the source station, at the CCP, at the destination, and in some cases at the "old" DP to provide an alternate path. Since NORSAR, the SIP, and the DP were all essentially being checked out simultaneously with the CCP and not in fully operational status, scheduling for these tests was difficult and several attempts at the tests had to be aborted.

These tests are grouped with two test sequences each for the DP and SIP. The first tests demonstrated data exchange (type Ø messages) and the second tests demonstrated other message types required by the communication protocols.

2I and 2L-Sending Data Messages to DP and SIP

For these tests of the type Ø (data) messages, the system was in configuration 1 providing data paths to "old" DP independent

of the CCP for comparison with those going through the CCP. Test 2I with DP was conducted December 3, 1975 (day 337). The data collected include 1) the CCP terminal outputs including data buffer core dumps, 2) 16 waveform plots from the CCP hard copy device, 3) dumps and plots of data from the "new" DP tape (tape 5), 4) dumps and plots of data from the "old" DP tape (tape 6), 5) dumps of data from NORSAR DP (tape 2), and 6) dumps of data from 360/44 tapes (tape 4).

Test 2L was attempted on December 2, but some of the data from sites was lost. The test was run again on January 8, 1976. The data for this test repeats that collected for test 2I but also includes dumps of data messages received at the SIP.

2K and 2M-Verification of Other Messages

For these tests the system was used in configuration 2 with EP in operation. Type Ø messages are data messages and were checked in the previous tests.

Type 1 (acknowledge messages) were first tested by inserting program patches to count the number of acknowledge messages at the sending and receiving locations. Next a patch in the sending station caused acknowledge messages to be skipped at a known rate and the effect on the count at the receiver was observed.

Type 4 (host-going-down) messages were tested by having the operator at the destination site command his system to send a type 4 message to the CCP. When the message was received at the CCP a warning was typed to the CCP operator confirming the exchange.

Type 5 (operator) messages were tested by sending messages from the CCP operator to each remote station and requesting the remote operator to send the identical message back to the CCP operator.

Type 7 and 8 messages were demonstrated as part of test sequences 2J and the test was repeated in this sequence.

The type 9 (data filed) message is transmitted from the SIP to the CCP. It was tested by forcing the SIP to send such a message and observing that the CCP received the message and informed the operator.

Tests of the type 10 and 11 messages are included in test sequence 2E.

Test 2K and 2M were performed on December 11 and 12, 1975 (days 345 and 346). In addition data from December 2 demonstrating some of these message exchanges is included in the data volumes.

The test data consist of CCP terminal outputs and dumps of messages received by the DP and SIP.

PHASE 3: RELIABILITY SOFTWARE

The tests in this phase were designed to demonstrate 1) the ability of the CCP reliability software to recognize and recover from various forms of solid hardware failures and 2) that the CCP hardware can be split into two logical machines, one running the operational program and the other running system test programs.

For the first tests in this phase, hardware failures were caused by disconnecting devices from the fantail panels and by turning off power to various modules.

In the second part of this phase the HALF command which causes the operational program to use only one processor bus and one MI bus was executed, and the busses not being used by the operational program were loaded and run with HIT and DDT.

The last step in this phase consisted of demonstrating the operator ability to merge the interactive and output

typewriter functions onto either of the two typewriter terminals. Phase 3 tests were conducted on January 16, 1976. The test data consist of the CCP terminal outputs from the tests.

PHASE 4: SYSTEM OPERATION

This phase of the acceptance test consisted of allowing the entire available seismic network to operate with the CCP for 24 hours under normal operating conditions. This test was performed on February 5 and 6 of 1976. The data for this test consist of the CCP terminal outputs. Starting at the beginning of February, the CCP terminal outputs were collected and bound as operating logs for the CCP. The data from this test are, therefore, in the CCP operating log.

PHASE 5: PROGRAM SUPPORT SOFTWARE

Phase 5 of the acceptance test demonstrated the program support software including the editor and assembler on the TENEX system. The demonstration consisted of connecting to the ISI TENEX over the ARPANET from a terminal at SDAC, using the editor to enter a source program, assembling the source program, and using a special PLURIBUS File Transfer Protocol to send the object program to the CCP where it was punched on paper tape using the CCP punch. This tape was then read into the CCP and the program was run on the CCP.

The test was performed on December 16, 1975. The test data consist of 1) the CCP terminal outputs including results of running the assembled program, a program to compare a tape with the contents of memory, on the FTP program (differences are variables changed when the in-memory version was run to transfer the assembled compare program over the ARPANET), 2) the paper tape, 3) program listing and 4) the concordance from the assembly.

Sample Event

In addition to explicit acceptance test results, data from a seismic event recorded with the new data collection network system (using the CCP) on February 4 are included in the test data volumes.

CONCLUSION

The acceptance test sequence ending on February 6, 1976 provided an adequate demonstration that the CCP hardware and software met specifications and the system was accepted by the Air Force.

Operation of the system during acceptance tests and seismic data network debugging revealed several refinements in the CCP system, particularly in the operator interaction, that would significantly enhance the ease of system operation and the network reliability. These include several changes in the waveform display and scaling, the ability to load the CCP program from another ARPANET host and to load CCP parameters from premade paper tape (to reduce keyboard entry of parameters), and a more robust network control program (and possibly improved host/host protocol).

Appendix I

BBN Report No. 3185

BOLT BERANEK AND NEWMAN INC

CONSULTING · DEVELOPMENT · RESEARCH

Report No. 3185

ACCEPTANCE TEST PROCEDURES FOR THE
COMMUNICATIONS AND CONTROL PROCESSOR

9 April 1976

Principal Investigator: Howard W. Briscoe
Telephone (617) 491-1850, Ext. 415

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Attn: Capt. R. Wilde

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Communication and Control Processor Acceptance Test Procedure

The following document defines a series of tests that demonstrate all the currently useable features of the CCP.

The acceptance test procedure is divided into four numbered phases. Each phase is divided into one or more lettered sections. The sections are designed to be independent from one another. Should the CCP be unable to successfully complete a certain section (or sections), only that section (or sections) will be required to be retested.

Ideally, each input site (ALPA, LASA, and NORSAR) should provide a sine wave of known amplitude and frequency on one Long Period (LP) and one Short Period (SP) channel. If that is available, that channel should always be included among those tested. If not available, an otherwise identifiable channel should be chosen.

A block diagram of the expected system configuration during the acceptance test is given in Figure 1 for reference during the tests.

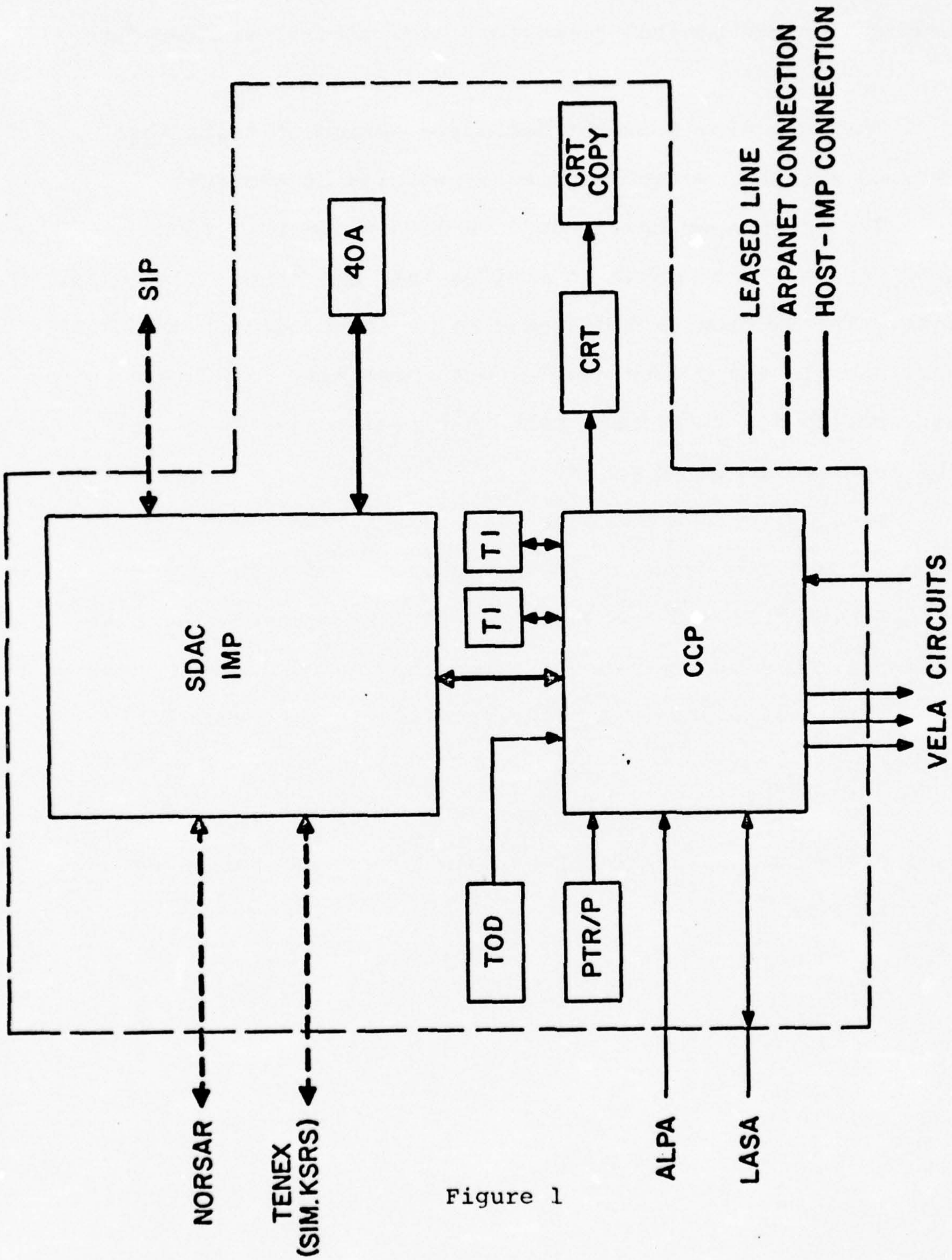
LEASED LINE
ARPANET CONNECTION
HOST-IMP CONNECTION
SIP
40A
CRT COPY
CRT
SDAC IMP
T1
T1
CCP
VELA CIRCUITS
TOD
PTR/P
NORSAR
TENEX (SIM.KSRS)
ALPA
LASA

Figure 1

PHASE 1 - System Testing

1.A HIT hardware test program

HIT is a general Pluribus system test configuration program that can be configured for many Pluribus configurations, including the CCP. It tries to test as many of the hardware features of the machine as it can, although not necessarily in the exact same way that an operational program might use them. All Processors run the test simultaneously, but asynchronously. Since a test program such as HIT must execute on and use the facilities of the hardware that it is also testing, there is potential for confusion. Thus the program is written to be suspicious of the hardware it is executing on and tries to rely on as few of the hardware features as possible for its actual execution. Thus each processor executes its tests quite independently from all others, all of the code is contained in each processor's private memory (where it is less vulnerable to corruption), the locking feature of the bus couplers which provides hardware protection against two or more processors accessing the same resources simultaneously is not depended upon for program execution, etc.

The program flow for each processor is divided into two main parts: the memory test and the Input/Output (I/O) test. For the memory test, the processors are assigned non-overlapping

areas of the available common memory. Each processor then tests randomly selected addresses with random data within that area. The lock feature of the couplers is also tested. The I/O test exercises the various I/O devices, such as the Host interface or checksum-block transfer device, and the polling devices, exemplified by the Synchronous Line Interface (SLI). The devices are usually run crosspatched, although they can also be externally looped, run through an echoing machine, or even connected to each other. The program sets up buffers of random data of random length and sends this data through each device. When completed, the incoming data is checked for consistency with what went out and all of the values of the status and control bits are checked for their proper values. A rudimentary test of the Pseudo Interrupt Device (PID) and the Real Time Clock (RTC) also takes place in the I/O test.

Each processor maintains a list of any errors it has detected in its local memory for later inspection by the operator The processors also attempt to communicate their status through a common memory communications area. If a console is available, one processor is designated to display some of this information in the lights. This common memory area is also used for information of global interest, such as buffer pointers for devices (which might be serviced by any processor.)

1.A.1 Load HIT

To run, the program is loaded into one of the processors, which is also the one which runs DDT. Using DDT, or a patch tape, the appropriate configuration to be tested and other parameters of the test are entered. Using the DDT ^B and ^G commands, the program is copied and started in the other processors. A bit in the lower row of console lights will blink for each processor which is running. The corresponding bit in the upper lights will blink when that processor discovers an error. In addition, the leftmost bit of the lower row will come solidly on and the next bit will blink for any error discovered. The details of the errors can be discerned by examination of each processor's error buffer. Details of the error formats and parameters are given in the listing.

The following pre-run time modifications are necessary to configure HIT to test the CCP:

1. The starting address of the memory busses - BGADDR

   1F30/ 0

   1F32/ 6000

2. Number of 4K memories on each bus - NO4KS. This is normally 10., but one memory on the 6000 bus is used for DDT. The C000 bits mean don't do I/O from the F bus to zero memory.

1F34/	CØØA
1F36/	9

3. Hosts to test - MD1ADR.

1F4Ø/	E14Ø
1F42/	F14Ø

4. CBTs to test

1F44/	E12Ø
1F46/	F12Ø

5. SLIs to test - SLIADR.

1FBE/	E16Ø
1FCØ/	E168
1FC2/	E17Ø
1FC4/	E178
1FC6/	E18Ø
1FC8/	E188
1FCA/	F16Ø
1FCC/	F168
1FCE/	F17Ø
1FDØ/	F178
1FD2/	F18Ø
1FD4/	F188

5. Don't process remote power fail interrupts - OPTION.

1FØA/	2Ø

6. Select a processor to handle devices - MODPNO.

   1F18/ 22

7. Select a DDT processor - DDTPNO.

   1F1A/ 22

8. Split the memory among the 4 processors - ANDBTS.

   1F1C/ 1F7A

9. Set DDT start address - DDTSA.

   1F1E/ 4ØØØ

10. Choose a memory for DDT - DDTMAP.

   1F2Ø/72ØØ

HIT Will be started at address 7ØØ(hex). The error buffer, described on page 96 of the HIT listing, resides in locations 5ØØ to 63Ø.

1.B Isolate Faulty Card

HIT will be used as a diagnostic tool to help isolate faulty hardware. To demonstrate this feature, a BBN person will supply a group of faulty cards. The test witness will choose one and the BBN person will insert it into the CCP and show how to use HIT to help locate it. The errors will be identified using

console lights and a printout of the error list maintained in the local memory of the processor.

1.C 24 Hour Test

HIT will be run continuously for 24 hours with all I/O devices internally crosspatched. If errors occur, the test will be stopped, causes of the errors logged by printing out the error list in each processor, repairs made if necessary, and the test will be restarted. This phase of the acceptance test will end when 24 hours of error free operation have been logged. Power line voltage will be monitored. Should errors be caused by power line fluctuation the test will not be stopped. A power line fluctuation is defined as the line voltage remaining below 7Ø volts for one half cycle.

PHASE 2 - The Operational Program

The operational Program will be loaded into the machine. All parameters in Appendix 2 should be initialized. Complete details of all operator commands will be found in the user manual.

Section 2.A - Operating the display (using the ALPA data)

2.A.1 List the ALPA channels.

If they have not been previously specified, they can be with the SPECIFY command:

```
SPECIFY ALP<cr>
   SP:<cr>          /there are no SP channels at ALPA
   LP:  ALPØ1IHxxxxl<cr> /fill in the 12 character name
   .
   .
   .
   LP: <cr>     /terminate the prompted input
```

An incorrect channel name will be included.

Now they can be listed:

LIST ALP<cr> /list the channels at ALPA

The incorrect names will be corrected and given a status by the REPLACE command:

REPLACE <current ID> <new ID> <optional status><cr>

status values may be N = No data
C = Calibration
E = Communication error
S = Suspect

The LIST command will be repeated to confirm the result of the REPLACE command.

2.A.2 Display an ALPA channel.

The display command uses the twelve character channel IDs, a gain factor, and a position on the screen. There are eight possible positions on the screen, referred to by the numbers Ø through 7.

DISPLAY <channel ID> <screen position> <gain><cr>

2.A.3 Change the time base of the displayed pattern.

The default time base is 3Ø seconds. Change it to 1ØØ seconds by:

DURATION 1ØØ<cr>

2.A.4 Freeze the picture on the screen.

The display will be stopped by:

HOLD<cr>

2.A.5 Print a copy of the screen.

A hardcopy of the contents of the screen will be produced by depressing the "Make Copy" switch on the keyboard console of the display device.

2.A.6 Resume displaying data.

Data will once again be displayed (from the current time onwards) by:

CONTINUE<cr>

2.A.7 Change the gain factor and screen position.

The gain factor and screen position of one channel will be changed by reissuing the display command with a different argument in the "gain" position:

DISPLAY <channel ID> <screen position> <new gain><cr>

Displayed values will be compared with a hex dump of data from magnetic tape.

2.A.8 Terminate displaying a channel.

Channels will be terminated by the use of the END command:

END <screen position>

2.A.9 Setting and Examining Parameters

The gain factor of one channel will be changed using the SET command. The change will be verified using the PRINT command and the display of the modified channel.

Section 2.B - Processing ALPA data.

2.B.1 Check and set up all the constants.

If the ALPA channels have not yet been specified, they must be done as specified in section 2.A.

In addition, there are many error constants and error limits for each input site which are described in The User Manual. The following ALPA values will be used for the test and may be printed with the PRINT command.

HL	High Long Period Gain	.288
LL	Low Long Period Gain	1.Ø
MC	Missing Message Constant	.Ø625
MG	Missing Message Good Limit	.3
MB	Missing Message Bad Limit	.7
CC	Checksum Constant	.Ø625
CG	Checksum Good Limit	.3
CB	Checksum Bad Limit	.7

OC	Operator Missing Message Constant	.Ø625
OG	Operator Missing Message Good Limit	.25
OB	Operator Missing Message Bad Limit	.75
PC	Operator Checksum Constant	.Ø625
PG	Operator Checksum Good Limit	.25
PB	Operator Checksum Bad Limit	.75
NC	No Data Constant	.Ø625
NG	No Data Good Limit	.2
NB	No Data Bad Limit	.8
EC	Communications Constant	.Ø625
EG	Communications Good Limit	.2
EB	Communications Bad Limit	.8
SC	Suspect Data Constant	.Ø625
SG	Suspect Data Good Limit	.2
SB	Suspect Data Bad Limit	.8

In addition, there are two others which are not applicable to ALPA. They are:

HS	High Short Period Gain
LS	Low Short Period Gain

2.B.2 Display ALPA data.

Two ALPA channels including one with a calibration signal will be displayed using the procedures described in Section 2.A.

2.B.3 Verifying ALPA data.

Several randomly selected ALPA channels will be displayed. Near the end of a display frame the CCP will be stopped. ALPA data messages will be listed using DDT and a TTY for comparison with plots and dumps of data being stored on mag tape by the Detection Processor (DP) in parallel with CCP operations, and with plots from the CCP.

Section 2.C - Test ALPA Beams.

As in Section 2.B, the module that creates ALPA Beams requires certain constants and limits included in the set up procedure in Appendix 2. These include the following beam parameters:

RC	Site error constant	.Ø625
RG	Site error good limit	.2
RB	Site error bad limit	.8
ST	# of bad sites per component tolerated Ø<=n<=19	15
TU	upper tolerance scale factor	1ØØ
TL	lower tolerance scale factor	.Ø1
QT	# bad channels/component tolerated with bad status	15
AR	mean calculation (1/c)	.Ø5
AD	mean calculation deviation	2Ø
QR	quality checking (1/c)	.125
BC	station error constant	.125
BG	station error good limit	.2
BB	station error bad limit	.8

2.C.1 Define beams

In this step, 4 beams will be defined. The beams will include two rotated single sensors, one sensor beam using the

sensors in the first two beams, and a standard Air Force beam using all sensors. The sensors used in the first 3 beams will contain normal seismic data. In the following commands, the channel IDs are the names of the resulting beams. These are the names which will be supplied to DISPLAY to show the beams on the display screen. Seismometers can be excluded from the beam by giving a null delay. Rotation of a single seismometer can be done by defining a one site beam. Beams will be created as follows:

```
BEAM 1 <cr>
  COMPONENT VERTICAL:  APPØ1BHAØ3ØZ <CR>
  COMPONENT RADIAL:  APPØ1BHAØ3ØR <CR>
  COMPONENT TRANSVERSE:  APPØ1BHAØ3ØT <CR>
  ANGLE:  3Ø* <CR>
  DELAY 1:  <CR> Note:  This is an example of a "null" delay.
  DELAY 2:  Ø <CR> Note:  This is an example of a zero delay.
  DELAY 3:  <CR>
    "
    "
    "
  DELAY 19:  <CR>
```

```
BEAM 2 <CR>
  COMPONENT VERTICAL:  APPØ1BHBØ3ØZ <CR>
    "
    "
  ANGLE:  3Ø* <CR>
  DELAY 1:  9 <CR>
  DELAY 2:  <CR>
    "
    "
  DELAY 19:  <CR>

BEAM 3 <CR>
  COMPONENT VERTICAL:  APPØ1BHCØ3ØZ <CR>
    "
    "
  ANGLE:  3Ø* <CR>
  DELAY 1:  9 <CR>
  DELAY 2:  Ø <CR>
  DELAY 3:  <CR>
    "
    "
  DELAY 19:  <CR>
```

BEAM 4 <CR>

COMPONENT VERTICAL: APPØ1BHDØ6ØZ <CR>

COMPONENT RADIAL: APPØ1BHDØ6ØR <CR>

COMPONENT TRANSVERSE: APPØ1BHDØ6ØT <CR>

ANGLE: 6Ø* <CR>

DELAY 1: 18 <CR>

DELAY 2: 23 <CR>

DELAY 3: 13 <CR>

DELAY 4: 9 <CR>

DELAY 5: 5 <CR>

DELAY 6: 14 <CR>

DELAY 7: 26 <CR>

DELAY 8: 15 <CR>

DELAY 9: 1Ø <CR>

DELAY 1Ø: 6 <CR>

DELAY 11: 7 <CR>

DELAY 12: 11 <CR>

DELAY 13: 12 <CR>

DELAY 14: 17 <CR>

DELAY 15: 21 <CR>

DELAY 16: 16 <CR>

DELAY 17: 21 <CR>

DELAY 18: 24 <CR>

DELAY 19: 19 <CR>

2.C.2 Verify which beams are now defined.

This is done by:

ALPA<cr>

which will list all the currently defined beams.

2.C.3 Start calculation of the beams.

To start calculation of a beams use the commands:

START 1 <CR>

START 2 <CR>

START 3 <CR>

START 4 <CR>

2.C.4 Display beams.

After starting the beam computations, display the three components of beam 4 as follows:

DISPLAY APPØ1BHDØ60Z 1 1 .ØØ1 <CR>

DISPLAY APPØ1BHDØ6ØR 2 3 .ØØ1 <CR>

DISPLAY APPØ1BHDØ6ØT 3 5 .ØØ1 <CR>

2.C.5 Verify beam computation

After enough time has elapsed to fill the screen with beam data, stop the CCP. Take a hard copy and visually compare with the corresponding plots of the existing Air Force beamforming programs. Take dumps of the 3Ø second ALPA data buffer and the output buffers containing beams and perform the following checks:

Seismometer rotation will be checked by performing the following hand calculation on three most recent input data values from site 2 (3-Ø2) and comparing with the components of beam 1 from the dump:

define S = N-S input channel from site 2

E = NE-SW input channel from site 2

W = NW-SE input channel from site 2

then the values of

APPØ1BHAØ6ØZ = .577(S+E+W)

APPØ1BHAØ6ØR = .7Ø7(E-S)

APPØ1BHAØ6ØT = .815(.5S+.5E-W)

Beamforming will be checked by performing the following hand calculations on corresponding components of beams 1 and 2 and comparing with beam 3:

2x beam 3 (T) = beam 1 (T) + beam 2 (T+9).

Beamforming and beam display will be further checked by comparing values of beam 4 from the hex dump with the displayed beam and with an Air Force plot and hex dump of the beam data from the "old DP" output tape.

Finally, the command to stop beam calculation

STOP 4 <cr>

will be executed causing the data traces on the display to stop.

2.C.6 Checking beam and quality checking parameters.

2.C.6.A Site error parameters.

Site error parameters will be checked by creating a beam from just one site which happens to be good. Using the REPLACE command set the status to be bad. The beam will become null until the time constant causes the channel to be declared good again. A second beam using this site and a site declared bad at the ALPA station will be formed and the two beams compared to show that the bad site is not being used in beamforming.

2.C.6.B Check mean and quality calculations.

For the following tests, one ALPA site will provide a sequence of three test signals for approximately 1Ø minutes each. The test signal consist of a 25 μm. step function lasting at

least 3 minutes, a 2μm. square wave with a period between 30 and 60 seconds, and a 50 nm. square wave with a period between 30 and 60 seconds.

Two normal operating sites will be selected. A beam containing the two normal sites and the test site all with zero delay and a beam conditioning only the test site will be formed.

The test site channels and the beam channels will be displayed.

The time constant for the calculation of the mean bias will be checked by observing the decay of the step function.

The time constant for computing the power average will be checked by observing the time period between the start of small square wave and the appearance of the square wave on the three site beam which is delayed until the average power of the square wave enters the power gate controlled by the normal seismometers. Further checks will be made by typing the average power of the test site beam on the operator console several times during the rise of the step function and the large square wave.

Masking of sites with abnormal power will be demonstrated by the inclusion of the test site in the three site beam during the small square wave and rejection during the large square wave and step function.

Section 2.D - Processing LASA Data.

2.D.1 LASA Constants

The constants will have been set-up during initialization. The values will be verified with the print command.

2.D.2 Display LASA data.

Four channels will be displayed using the procedures described in section 2.A. If available, the one calibration sine wave will be included among the channels displayed as a check on data quality. Other channels will be one LP channel, one SP sensor channel and one SP beam. Data will be compared with a hex dump at selected points.

2.D.3 Send an operator message to LASA

Messages may be send to sites such as LASA, equipped to receive operator messages by the use of the TELL command:

```
TELL LAO<cr>
  -<text of message><cr>
  -<another line of text><cr>
  -<cr>
```

Messages received from sites such as LASA are printed automatically on the system status typewriter (TTY 2). A message will be sent from LASA and will be typed in the form:

```
L:<text of message>
```

2.D.4 Verifying LASA data.

Several randomly selected LASA data messages will be listed using DDT and a TTY for a hexadecimal dump comparison with LASA data being stored on mag tape in parallel with CCP operation. It will be necessary to halt the CCP program to obtain this data.

2.D.5 Verify idle messages from CCP to LASA

Once each second the CCP sends a pseudo operator message to LASA. This will be verified by unplugging the LASA output line from the fantail panel. LASA operator will verify that messages stop and resume when cable is unplugged and then replaced.

Section 2.E - Processing NORSAR data

2.E.1 Specify the sites.

NORSAR and LASA and/or ALPA site channels will be SPECIFIED and the error constants and limits SET during initiation (appendix 2). LASA and ALPA are sources of data to be sent to NORSAR.

2.E.2 Receiving NORSAR Data.

2.E.2.A Verify and display received NORSAR sensor data

Run both old and new DP systems at NORSAR and SDAC to provide independent data path.

Set up CCP display to display NORSAR data.

After this configuration has been running for several minutes stop CCP near the end of a display frame. Collect and compare plots and dumps or listings of the same data recorded by old and new NORSAR DP old and new SDAC DP, and CCP plots and core dumps.

2.E.2.B Verify received detection log and EP results.

Run NORSAR in new mode with both DP and EP.

After system has been running for several minutes (long enough to get some EP output) recording on tape at NORSAR and SDAC, collect and compare NORSAR detection log and EP results recorded at NORSAR and SDAC.

2.E.2.C Test Operator messager from NORSAR

Operating in new DP mode, NORSAR operator will send a message to CCP operator.

2.E.3 Sending data to NORSAR

2.E.3.A Sending LASA and ALPA data to NORSAR

Operate NORSAR and SDAC with both old and new DP systems running and recording data to provide independent data paths.

Display selected LASA and ALPA channels on CCP display.

After the system has been running for several minutes, stop the CCP near the end of a display frame. Collect and compare plots and listings or dumps of selected LASA and ALPA

data from 1) PDP-7 recordings at LASA 2) old DP at SDAC, 3) new DP at SDAC, 4) CCP, 5) NORSAR DP.

2.E.3.B Sending data requests and processed data to NORSAR

Operate SDAC and NORSAR in new mode with EP operating.

Initiate a request for selected NORSAR SP data and display NORSAR SP data at CCP. Verify that the requested data is being received and displayed. Collect and compare dumps or listings of SDAC detection log at SDAC and at NORSAR.

2.E.3.C Test operator messages to NORSAR

Operating in new mode, CCP operator will TELL NORSAR a message. NORSAR operator will verify receipt of the message.

Section 2.F - Receiving KSRS and Site II data.

2.F.1 Prepare to use simulator.

The KSRS simulator runs on the BBN-TENEXA system in Cambridge, Massachusetts. Unfortunately, the TENEX clock is running on Eastern Standard Time (EST) plus or minus about 1 min.. Therefore the CCP clock must be set to that time in order to receive data. This will require halting the CCP program to determine the exact time difference.

2.F.2 Specify the KSRS site.

The simulator has 1Ø short period channels and 2Ø long period channels. Channel specification is part of initiation procedure (Appendix 2).

2.F.3 Set up the error rates.

Initialization will have been done as in Appendix 2, although it should be noted that the simulated data does not have a valid checksum on any of its messages. Also, the simulator provides only data messages.

2.F.4 Display a channel.

This will be done as in section 2.A. The simulated LP channels are continuous levels of several different gains, and the SP channels are saw tooth waveforms. Parameters of these signals are as follows:

LP Channel #	value of each sample
1	Ø
2	1
.	.
.	.
2Ø	19

SP Channel #	the 2Ø values per second
1	Ø, 1Ø, 2Ø, ...19Ø
2	1, 11, 21, ...191
.	.
.	.
1Ø	9, 19, 29, ...199

Stop CCP and collect core dump to compare with simulator levels.

2.F.5 Site II

Change host ID of simulator and repeat 2.F.4.

Section 2.G - Processing data for the VELA circuit.

This section will be tested using the full duplex telephone circuits provided for VELA 3. Data will be verified by hexadecimal dumps at both ends.

2.G.1 Sending data on the VELA 3 line.

Data will be send on the VELA 3 line from any of the following sources available to the CCP: ALPA, ALPA beams, LASA, and NORSAR. The choice of sites and channels is made using the SEND command:

SEND<cr>

SHORT PERIOD CHANNELS

HOST: <site ID><cr>

ALL CHANNELS? <yes><cr> /yes sends all SP channels from chosen site

HOST: <site ID><cr>

ALL CHANNELS? <no><cr>

CHANNEL: <channel ID><cr>

CHANNEL: <cr>

LONG PERIOD CHANNELS

HOST: <site ID> <cr>

(same as SP channels)

HOST: <cr>

In order to easily verify data quality, at least one calibration sine wave should be included among the channels sent. Block waveform data will not be sent. Selected data will be displayed at the CCP. After several minutes of operation, the CCP will be halted and dumps of recent output data will be recorded. Dumps and plots of data from the CCP will be compared with dumps and plots of data from the VELALINK. Note that beam data on the VELALINK is delayed 25 seconds and sensor data is delayed 10 seconds.

2.G.2 Receiving operator messages from VELA.

Operator messages will be received from VELA via the reverse link of one of the VELA lines. A message addressed to the CCP operator will be received and will be automatically printed on the status TTY (TTY 2). They have the form:

HC: <text>

2.G.3 Checking Codex Modems

Correct modem operation will be demonstrated by switching to each of the three modems for VELA communication. One of the modems will be located at the highest of the 4 spaces to demonstrate that the cables will reach all modems.

Section 2.H - Changing and Interrogating CCP status.

2.H.1 Print and set host IDs.

The ARPANET address of a host will set with command, for example:

SET NH 41<cr>

will set the address of NORSAR to be 41. Verify this by:

PRINT NH<cr>

which will print the current host address for NORSAR. The other host IDs and addresses (where known) are:

NH	NORSAR	41.
KH	KSRS	?
IH	ILPA	?
2H	SITE 2	?
4A	360/40A DP	167.
SH	SIP	223.
4H	360/44	295.

If data normally sent to the 40A were to be sent to the 40B instead, then the ARPANET address of the 40B would be associated with 4A using the set command.

2.H.2 The STATUS and PREFER commands.

The

STATUS<cr>

command causes a printout on the status TTY of:

1. Input site status table

2. ARPANET host table
3. CCP device table
4. CCP map table
5. CCP illegal instruction trap table.

This same list is also periodically printed by the system to provide a permanent record of system behavior. All devices in this list are given a two letter identifier (see CCP User manual for device identifier list).

A different interface or no interface may be selected by the operator by use of the PREFER command. For example:

PREFER AL Ø<cr>

will cause the system not to receive ALPA data. Whenever the system decides to change the device it is using, it will so inform the operator on TTY 2 and it will sound the audible signal. The use of this command will cause the system to confirm the new choice. Each device has two possible interfaces that may be used. In each case the system will try to automatically choose the interface that is actually connected to the device. In the case of a modem the system will look for carrier. In the case of the IMP, the system will look for IMP READY. In each case, the CCP, unless told to use no device, will

choose the one that is active. Therefore, if the ALPA modem is connected to the E16Ø interface and the operator PREFERs the F16Ø interface, the system will NOT switch over, unless the F16Ø interface is active. This will be verified by displaying ALPA data, PREFERing AL to Ø, seeing the data stop, PREFERing AL to the active interface, and seeing the data reappear.

2.H.3 The OUTPUT command.

The OUTPUT command permits the operator to divert the data stream normally sent to the status TTY to either of the TTYs or to the display. The command is:

OUTPUT <1,2, or DI><cr>

where the choices are:

1	The normal interactive TTY
2	the normal status TTY
DI	The display

The series of commands to demonstrate this command and its interaction with the display will be:

HOLD	to stop the current display
OUTPUT DI	to divert status to the display
STATUS	list system devices and status

OUTPUT 2 resume using the status TTY

CONTINUE continue graphics display

Section 2.I - Sending data to the 4ØA (DP)

The 4ØA always receives NORSAR offline results. In addition, data from any of the sites may be sent to the 4ØA by use of the SAVE command.

2.I.1 Send data to the 4ØA.

Sending data to the 4ØA will be set up with the SAVE command:

```
SAVE 4ØA<cr>
  SP: <site name><cr>
  .
  .
  SP: <cr>
  LP: <site name><cr>
  .
  .
  LP: <cr>
```

In order to provide automatic backup, in the event that the SIP is down, all data specified to be sent to the SIP is, instead, sent to the 40A in addition to NORSAR offline data, and the 40A SAVE specification is ignored. Therefore, to restrict the data, for example to send just the ALPA data to the 40A, with no SIP, the SAVE command will be given:

```
SAVE SIP<cr>
  SP: <cr>
  LP: ALP<cr>
  LP: <cr>
```

The switch from SIP to 40A SAVE specification may be forced by use of the SIP DOWN command. The inverse may be performed with the SIP UP command.

In order to provide an independent data path for comparison the "old" Detection Processing (DP) system will be run in the other 360/40. The CCP display will be set up showing one or more waveforms from each source site being used in the test.

After running for several minutes, halt the CCP and dump the output buffers. Dumps or listings and plots of selected sections of waveforms will be collected from the source site, from the CCP, from the "new DP" system, and from the "old DP" system and will be compared to confirm correct system operation.

2.I.2 Switch output to the 4ØB

Use the SET command to associate the 40B ARPANET address with host ID 4A.

2.I.3 Get requested data from NORSAR.

NORSAR sends off-line processed data to the CCP which is then forwarded to the 4ØA. The CCP or DP operator will request specific data by use of the REQUEST command:

REQUEST <cr>

- <# of SP channels, Ø-3><cr>
- <# of subarray/array beam values, Ø-3><cr>
- <1st beam number, Ø-999><cr>
- <2nd beam number, Ø-999><cr>
- <3rd beam number, Ø-999><cr>

NORSAR data, CCP data, and 4ØA data will be compared by dumps from each machine.

2.I.4 Testing network retransmission and acknowledges

If the 4ØA can so arrange, it will suppress the ACK from every 2Øth message. A retransmission counter will be kept in the CCP. After a known period of operation in this mode the CCP retransmit counter will be printed and compared with the value determined from the operating time. Both machines will be stopped and acknowledge messages will be checked with hex dumps.

2.J Testing Changes in Data Status

2.J.1 The LIST command will show the current status of a channel.

LIST ALP <cr>

ALPØ1IH03231 <STATUS>

.

.

. status may be blank (good data) or a sequence of four possible characters representing current status (more than one may be present). Possible status characters are

N	no data
C	calibration

E	communication error
S	suspect data

2.J.2 A data source will be made to fail by pulling a modem plug. The ALPA fantail plug is removed, and the system will inform the operator of this change on TTY 2 and will sound the corresponding audible alert. A status message will be sent to the 4ØA (assuming the SIP is down). The status will be checked with a hex dump from the 4ØA.

2.J.3. If the project officer can provide a mechanism for selectively breaking the checksum (or polycode) on a given stream of messages, then the error rate will be moved around so that the LIST command will report that the channels are either good, suspect, or bad.

2.K. Check all Messages Between CCP and 40A

The NORSAR Processed Data Messages, Seismic Data Messages, Acknowledge Messages, and Status Message have been checked with various steps above.

Action to cause the 4ØA to send a Host-Going-Down message will be taken. The message will cause a CCP operator message on TTY 2 with an audible signal. Message will be checked by stopping the CCP and taking a hex dump. The latest Processed Data to NORSAR message will also be checked by this hex dump and a dump from the 4ØA.

The CCP operator will cause a Structure Check Message to be sent. Hex dumps from the 4ØA and CCP will be used to check the resulting message.

2.L Sending Data to the SIP

The format of data messages to the SIP is the same as to the 4ØA. To demonstrate this capability, the procedure described in section 2.I.1 will be repeated with the SIP on and data "SAVE" to the SIP. Data will be dumped from the SIP and the CCP for comparison.

2.M Check All Messages Between CCP and SIP.

Type Ø (data) messages have been checked by the procedure in 2.L.

Type 1 (acknowledge) messages will be checked by having the CCP and SIP keep counts of messages sent and acknowledges received. After a period of operation stop and read the counts. A program change will then be made to suppress every n'th acknowledge and the system will be run in this mode for several minutes. The counts will be examined.

In order to demonstrate checksum computation the CCP will be stopped and a dump of some message will be taken. The checksum will be computed by hand and checked with the checksum in the dump.

Type 4 (Host-going-down) messages will be checked by having the SIP operator send a type 4 message to the CCP and observing the resulting CCP operator message on the TTY.

Type 5 (operator) messages will be checked by having the CCP operator send a message to the SIP operator and then having the SIP operator return the identical message to the CCP operator.

Type 7 and 8 (Structure Check and Status) messages will be checked by forcing the CCP to send those messages to the SIP by turning backup on and off. The CCP and SIP will then be

stopped and dumps of these messages taken at both sites and compared.

The type 9 (Data Filed) message will be tested by observing the CCP operator message on the TTY after the SIP has sent the message at a prescribed time.

PHASE 3 - Reliability

The CCP is designed with duplicate hardware so that no single failure will make the machine inoperable. However, since devices are connected to one interface at a time, they must be reconnected to the second interface in the event of an interface failure. Operator interaction is provided to assist in the choice of interfaces.

Memory and interface failure will be simulated without damaging the physical cards by shutting down the power on the bus into which they are connected. The CCP has, in essence, three different types of busses.

In order to verify that the CCP continues to operate, set it up to be receiving ALPA data and displaying a channel.

Section 3.A - Simulate an interface failure.

Simulate an interface failure by pulling out the ALPA fantail plug and replugging it into the other bus. The operator will be informed of the new choice of devices by a message of the following form and an audible alarm both on TTY 2. Data will resume being displayed.

USING AL <new address>

Section 3.B - Simulate a processor failure.

Power down the #12 processor bus (the one without the console and the display). After the system has stabilized and resumed operations, power the bus back up and wait for the system to restabilize.

Section 3.C - Simulate a memory failure.

Power down the F memory bus (center rack). After the system has stabilized and resumed operations, power the bus back up and wait for the system to stabilize.

Section 3.D - Simulate a processor bus failure.

Power down the #22 processor bus. Since both the console and the display are on this bus, they will not be available for system operation verification. Instead, exercise some of the functions described in Phase 2 section H. Power the bus back up and wait for the system to stabilize.

Section 3.E - Operate the machine while running the operational and test programs.

Since the CCP contains enough equipment redundancy to make two separate computes with memories, it is possible to split the system and continue running the operational program in one

half while using HIT diagnostics on the other. This capability will be demonstrated by the following tests.

3.E.1 Split the machine into two halves by using the HALF command:

HALF <numeric code = 8C94(HEX)><cr>

this particular code will cause the system to stop using the #12 processor bus and the F memory bus.

3.E.2 Now read a DDT into the unused memory bus.

First choose a memory to use, say the 7200 page:

SET PM 29184<cr> = decimal equivalent of 7200 hex

now put the DDT,16272 tape in the reader and give the read command:

PTR<cr>

3.E.3 Now read in the HIT test program and the patch tape that configures it as to which processor and memory to use. First set up which processor to load and which I/O bus to use to load it (this process is done via Backwards Bus Coupling). Since the system still controls the E bus, we should use that one, and we want to load processor 12. The global variable "PP" is set to the sum of the bus address (hex FØØØ) and the processor number (hex 12):

SET PP - 4Ø78<cr> = decimal equivalent of FØ12 hex

Now put the HIT,176 tape in the reader and issue the read command:

PTR<cr>

and the patch tape, in this case HIT,176 patch 12F (busses 12 and F):

PTR<cr>

Then using CCP DDT:

```
DDT 1 on <cr>
12:∧H
F8/72ØØ<cr>
FCØØ/72ØØ<cr>
4ØØØ∧G
```

3.E.4 At this point, the diagnostic DDT should be running on the F bus TTY and the test program can be run as discussed in Phas 1.

To start HIT: Using Diagnostic DDT type:

```
∧H   7ØØ∧G
```

Now copy HIT into other processor memory:

```
:   1Ø,1FFE∧B   7ØØ∧G
```

To stop HIT type:

```
-:  1FØ4/1<cr>
```

3.E.5 Before returning the 12 and F busses to the system, halt the HIT test program as described in the HIT documentation.

3.E.6 To reintegrate the system, once again use the HALF command:

HALF C14<cr>

The system will now gradually absorb the new components.

3.F Demonstrate System Operation Using Only One TTY

Disconnect TTY 1 then enter the command

PREFER T1 Ø on TTY2.

Next execute any command invoking prompts from the computer and any of the tests in the above procedures that cause an output message and observe that all of these operations and messages use TTY 2.

PHASE 4 - System operation

The operational system will be run for 24 hours under normal operating conditions.

PHASE 5 - Demonstrate Editor and Assembler.

Enter and assemble a program using the TENEX editor and assembler for the CCP. Punch the resulting tape and read it into the CCP.

APPENDIX 1 - Messages Typed By The CCP

<site name> MISCNT BAD

The rate of missing messages for this site has exceeded the BAD limit.

<site name> MISCNT GOOD

The rate of missing messages for this site has decreased below the GOOD limit.

<site name> CHKCNT BAD

The rate of checksum errors for this site has exceeded the BAD limit.

<site name> CHKCNT GOOD

The rate of checksum errors for this site has decreased below the GOOD limit.

USING <device name> <device address>

Now using the device given by the device address for the CCP system component given by the device name.

HOST DEAD: <integer>

The Host with host identifier specified by the integer is not accepting data from ARPA network.

<time> HOST GOING DOWN <integer>

The host with host identifier specified by the integer had declared that it is going down.

<time> TBM ACKNOWLEDGE <site name> <file name> <beginning time> <end time>

The SIP acknowledges successful transmission of data to its disk.

APPENDIX 2 - Setting CCP Paramaters

1. Naming channels at a site.

All sites should have their long and short period channels identified. Refer to the following section in the CCP User Manual: section 9.Ø Channel Naming Commands.

2. Each site requires certain parameters and constants that specify and describe the data. For a compilation of these parameters refer to the CCP User Manual, Appendix C.

APPENDIX 3 - Acronyms

CCP	Communication and Control Processor
LP	Long Period
SP	Short Period
I/O	Input/Output
DMA	Direct Memory Access
SLI	Synchronous Line Interface
PID	Pseudo Interrupt Device
RTC	Real Time Clock
DP	Detection Processor
DDT	Dynamic Debug Technique
SIP	Seismic Input Processor
TBM	Tera-Bit Memory
ALPA	Alaskan Long Period Array
LASA	Large Aperture Seismic Array
KSRS	Korean Seismic Research Station
ILPA	Iranian Long Period Array
NORSAR	Norwegian Seismic Array

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The Seismic Communication and Control Processor (CCP) was assembled and programmed during the period September 1974 to August 1975 using the BBN PLURIBUS multiprocessor architecture. Acceptance testing of the CCP was dependent on and interwoven with implementation and testing of the other nodes in the Seismic Data Network. Acceptance testing was divided into five phases. The last test phase was completed February 6, 1976.

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